GHD Materials Technology
"Asset owners and managers need durable structures to meet client expectations and manage the potentially significant economic and safety risks inherent with ageing infrastructure."

Chris Weale
GHD Service Line Leader, Materials Technology

Our goal is to deliver the lowest life cycle cost repair and maintenance strategies to our clients.

The investigation, repair assessment, remedial inspection, project management and asset management audition of structures/plan includes:

- Leading edge non-destructive testing techniques
- Analysis to predict future materials deterioration and remaining service life
- Repair alternatives at the forefront of remedial solutions development, including cathodic protection
- Audit of repaired structures/plant giving reassessment feedback into the investigation and repair process
Corrosion engineering
Our corrosion consultants provide services including:

- Materials selection and the development of corrosion protection strategies and specifications
- Design and commissioning of cathodic protection, corrosion prevention, corrosion monitoring and stray current mitigation
- Corrosion rate assessments and inhibitor/biocide evaluation in process systems
- Coatings evaluation, selection, and specification
- Surveys of existing facilities including corrosion audits, stray current investigations, coating defect surveys, and monitoring/maintenance/audit of cathodic protection and corrosion monitoring systems

Durability assurance
We advise owners, designers and contractors to achieve durable structures. This involves:

- Assess materials deterioration mechanisms during the design life
- Identify critical elements with respect to durability
- Determine how the selected design will achieve the durability objectives of identified critical elements
- Review of construction methods and QA/QC of durability critical construction processes
- Response on requests and audits during construction
- Post construction asset management inspection audits and maintenance to achieve acceptable durability during service life
- Durability plans to document findings during tender, preliminary design, detailed design, construction and completed project

Construction materials technology
We have experience in materials selection including:

- Product development and concept design
- Raw materials evaluation and approval before use
- Preparation of technical specifications or method statements
- Practical installation assessment
- Site trials design and evaluation
- QA/QC relevant to achieve technical compliance
- Trouble shooting materials problems, non-compliance and disputes
- Collaborate with laboratories to develop test programs to evaluate performance of materials in specific applications

Materials testing and research
GHD collaborates with laboratory facilities at the forefront of applied research in our materials fields. Our clients benefit from a unique combination of state-of-the-art knowledge and practical engineering skills.

Complementary services
- Asset management
- Climate change assessment
- Maintenance management
- Sustainable construction
- Structural design
- Project management
Why is durability planning important?

Major capital works, whether government or privately owned assets, must achieve the intended service life for acceptable return on capital employed. A durability philosophy throughout the project delivery will provide capital investment optimisation by appropriate design, construction and maintenance measures to achieve the asset owner’s intended service life.

Objective of durability planning

In engineering terms, durability planning is cost-effective selection of materials to achieve the intended service life. The technical analysis determines the nature and rate of materials deterioration for given environmental conditions.

Durability and design life

Design and construction to Standards in a particular country, or international Standards, may not achieve the asset owner required design life in a specific corrosive environment. Significant premature maintenance could be required. Asset owners may require a design life of 20, 50, 70, 100, 150, 300 years whilst Standards may state 40 to 60, 50, 100 or no comment on design life. Durability assessment evaluates, explains and provide solutions to all parties.
Our services

Preliminary design stage support
• Characterise macro and micro-environments for the structure
• Identify deterioration mechanisms for construction materials in the environments
• Model deterioration mechanisms to determine future service life of materials
• Select materials to achieve the required service life to lowest whole-of-life cost
• Identify potential materials related construction difficulties
• Prepare materials specifications
• Develop cost-effective inspection and testing programs

Detailed design stage support
• Durability audit of final design options
• Evaluate specific material options to stated performance criteria
• Review detailed material specifications for project elements with design and construction teams
• QA/QC requirements for durability sensitive critical elements of materials and workmanship
• Critical element programs to inspect, monitor and maintain

Construction stage support
• Develop optimum materials technical performance
• QA/QC focusing on durability critical issues
• Site trials relevant for all materials
• Contractor’s method statements

Operational support
• Materials evaluation
• Critical durability construction processes
• Cathodic protection and prevention systems
• Corrosion monitoring systems
• Troubleshooting construction difficulties
• Resolution of technical non-compliance and any disputes
• Review to confirm acceptable durability has been achieved prior to issue of works practical completion certificate

Operational support
• Asset management inspection audits and maintenance recommendations throughout the service life to achieve lowest whole-of-life cost
Leading edge
A global network of materials technology consultants means we understand your industry and your local operating environment. You will benefit from a proven track record with more than 30 years experience consulting in this area. Our team incorporates structural, materials and corrosion engineers specialising in the assessment of materials deterioration, concrete technology and corrosion protection. Performance characteristics are well known for reinforced concrete, steel and timber.

Services
• Condition investigations for concrete, steel and timber structures
• Sophisticated diagnostic techniques to determine deterioration mechanism
• Computer models of deterioration mechanisms predict future performance
• Structural assessment is completed from the deterioration conditions to relevant design codes and standards
• Life cycle cost comparisons are completed for alternative repair solutions
• Design and technical specifications are provided for remedial and strengthening works
• Preparation of maintenance plans
• Repair works documentation, quality control tests to confirm compliance, project management, site inspection of remedial works and ‘as repaired’ documentation
• Asset management inspection audits and maintenance to achieve lowest life cycle cost

Inspection, maintenance and audit - transportation, bridges
Capability
The general investigation approach is applied for concrete, timber and steel. The deterioration mechanisms are determined, future life is predicted and repair strategies formulated.

- Concrete
- Timber
- Steel
- Bridge components
- Cast iron
- Brick

Transportation structures assessment combines our engineering materials knowledge, materials testing, research and design consultancy
Inspection, repair and audit - property & buildings

Services

- Quick and cost-effective assessment of whether a building requires investigation
- Assessment of condition and diagnosis of deterioration cause(s)
- Thorough assessment of a building’s remedial work required
- Repair method statement for simple remedial works to allow contractors to competitively price a defined repair, giving owners control over workmanship
- Detailed specification with inspection and testing criteria for compliance with the specification
- Inspection with monitoring and testing of the remedial work’s quality at relevant stages
- Varying levels of repair works inspection chosen for specific project requirements, the property manager’s and owner’s requirements, and the experience and skills of the contractor
- ‘As repaired’ report compiled to factually record repairs completed, materials used and future maintenance/inspection appropriate for the owner-designated service life
- Contract documents prepared and administered for each level of project
- Asset management inspection audits and maintenance recommendations throughout the service life to achieve lowest whole-of-life cost
Our experience benefits building owners, property managers and contractors, ranging from small residential to high rise commercial buildings.

**Our materials experience**

- Reinforced concrete
- Structural steelwork
- Movement joints and sealants
- Cementitious toppings, plasters and renders
- Brickwork, concrete blockwork and mortar joints
- Flashings, gutters, downpipes and other plumbing
- Mechanical fixings, steel lintels and steelwork
- Protective coatings to interior and exterior environments
- Render, tile grout, tiles and tile pointing
- Exterior facade stone, brick, glass, metal and other finishes
- Handrails and fixings
- Roof level materials including waterproofing membranes, metal sheeting and supporting framework, and other finishes
- Damp proof layers
- Asbestos and other hazardous materials
- Timber elements
Corrosion engineering

Leading edge
Our team has pioneered technological developments from concept design to asset management of installed systems of Cathodic Protection (CP) to reinforced concrete and steel. We have been at the forefront of this rapidly developing technology since early 1980s.

Achievements

• Introduction of the first CP systems to reinforced concrete in Australia and Hong Kong, and CP development in the Middle East region
• Design, inspection of installation, commissioning and audit of CP systems to confirm acceptable performance of one of the world’s largest CP systems to a reinforced concrete marine structure (Kwai Chung Container Terminal) and to buildings (design for Burj Khalifa foundations and raft for the world’s tallest building)
• Continuous updating of design, installation and monitoring philosophies from existing CP systems audit data
• Involvement with CP installations to reinforced concrete and steel internationally
• Research and development of new anode types, monitoring probes, electronic corrosion monitoring hardware and design methodologies
The Materials Technology Group has been actively involved with research and development of Cathodic Protection (CP) Systems since the early 1980s

- More than 50 published papers and conference presentations on the subject of CP
- Internationally recognised materials testing and research

**Our services**

**Condition audits**
- Undertaken on reinforced concrete and steel throughout the world
- Experience in a variety of environments on reinforced concrete and steel
- Independent of any contracting operations or materials supplier

**Life cycle costing**
- Engineering cost estimates for the initial establishment

**CP design and specifications**
- One of the most experienced CP design consultants
- Design and specifications for CP projects, including cathodic prevention
- Independent advice on anode systems
- Assessment and mitigation of stray currents

**CP installation inspection**
- Knowledge in CP materials and project management
- Quality oriented engineering approach to achieve cost effective installation to owner designated service life
- Clients and contractors advice to achieve optimal installation
- Contractor’s method statements and inspection and test plans

**CP commissioning and monitoring**
- Qualified professionals in reinforced concrete and steel CP
- Commission and monitor CP installations
- Pragmatic and independent interpretation of monitoring data

**Verification of third party designs and specifications**
- Independent assessment of third party design and specifications
- Alert clients to associated risks and mitigation measures
- Dispute resolution

**Operational support**
- Asset management inspection audits and maintenance recommendations throughout the service life to achieve lowest whole-of-life-cost
- CP systems operating at optimal efficiency
Our team delivers solutions to material suppliers, contractors, consultants, asset managers and asset owners, including:

- Materials in service condition appraisal
- Materials chemical analysis, testing and performance evaluation
- Standard performance and specific testing
- Weathering environments specially designed for long term performance testing
- Protective coatings and repair systems performance assessment
- Chemical analysis of soils, including potential acid sulphate soils

**Laboratory collaboration**

We collaborate with laboratories accredited with the National Association of Testing Authorities, Australia (NATA), which is recognised internationally.

**Services - testing, evaluation and materials selection**

- Concrete mix development for any condition of exposure
- Evaluation of concrete for chloride penetrability and diffusion, water penetrability, alkali aggregate reactivity, adiabatic heat of hydration and early age thermal strain development
- Evaluation of concrete repair materials
• Concrete and masonry coatings evaluation
• Steel coatings evaluation
• Potential alkali reactivity by concrete prism, accelerated mortar bar, standard mortar bar and chemical methods
• Measurement of chloride, sulphate and cement contents, water permeability, water absorption/sorptivity, density, porosity and void content
• Coatings site compliance testing
• Potential acid sulphate soils analysis
• Instrumentation and technical support for field investigations, including - temperature and strain monitoring, adhesion strength and film thickness of protective coatings, flooring and linings, moisture content of concrete floors

**Failure investigation of:**

- Coatings
- Pipelines
- Steel
- Composites
- Waterproofing
- Facades

**Performance tests developed**

Specific tests developed by GHD include - cyclic salt spray and cyclic immersion resistance of coatings under tropical conditions (now Hong Kong Government standards), high temperature salt spray resistance of coatings, resistance of heat exchanger coatings to wood drying kiln condensate, accelerated sulphate resistance testing of concrete, sodium hydroxide resistance of concrete, slurry abrasion resistance of tank linings for a gold processing plant.

**Research**

Our team advances GHD's knowledge by research and development and maintains technical capabilities to meet our clients changing needs.

Our clients benefit from a unique combination of state-of-the-art knowledge and practical engineering skills. We collaborate with laboratory facilities at the forefront of applied research in our materials fields.
For more information and your local contact, visit

www.ghd.com/materials-technology

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